Inheritance of Cordate and Hastate Trifoliolate Leaves in Common Bean (*Phaseolus vulgaris* L).

Shree P. Singh and Carlos A. Urrea
CIAT, A.A. 6713, Cali, Colombia

The central leaflet of the trifoliolate leaves of common bean (*Phaseolus vulgaris* L.) is more symmetrical than the two lateral leaflets (Debouck 1991). Its shape can be cordate, hastate, or ovate (Singh et al. 1991). Of these, the cordate shape is more frequent in common beans of Middle American origin, especially in races Durango and Mesoamerica (Singh et al. 1991). In contrast, the hastate shape is more prevalent in races Chile and Peru of Andean South America, even though it has been observed in some accessions of race Jalisco from Middle America. The ovate shape is prevalent in both Andean and Middle American common beans. Because leaflet shape is an easily identifiable morphological trait and helps classify common bean germplasm into races and gene pools (Singh et al. 1991), mode of inheritance of cordate and hastate leaflet (Figures 1-1 in Singh et al. 1991) was studied.

Materials and Methods

The common bean germplasm accession G 2858 (Zacatecano) is from the Mexican highlands. It belongs to race Durango (Singh et al. 1991), and possesses a cordate central leaflet in each of its trifoliolate leaves. It has an indeterminate, prostrate, growth habit type III and is a landrace cultivar. Its seeds are medium-sized and rhombohedric, belonging to the pinto market class. In accession G 15935 (Kievits Boon) from the Netherlands, the central leaflet is hastate. The accession also has an indeterminate growth habit type III. Its seeds are large and oval and belong to the cranberry market class. Its characteristics conform to the Andean race Chile.

G 2858 was crossed with G 15935, using manual emasculation and pollination. The F_1 was backcrossed to both G 2858 and G 15935, and allowed to produce self-seeds (F_2). The parents, F_1, F_2, and the two backcrosses were grown in field plots in 1993 at CIAT-Quilichao (990 m elevation, with mean growing temperature of 24°C). The spacing between rows was 60 cm and between plants within rows about 15 cm. The shape of the central leaflet of the trifoliolate leaves (usually the first three lower leaves) was visually scored on an individual plant basis. Chi-square tests were performed to test segregation ratios in the F_2 and backcross populations.

Results and Discussion

The length of the hastate leaflet is often two to two-and- a-half times longer than that of the cordate leaflet. The F_1 of G 2858 x G 15935 had hastate leaflets. The F_2 segregated into a ratio of 15 hastate to one cordate (Table 1). Although the plant populations in the two backcrosses were small, all the progenies of the backcross of F_1 to G 15935 had hastate leaflets. The backcross to G 2858 also gave a good fit to the expected segregation ratio (three hastate to one cordate), even though the fit was better for a 1 : 1 ratio.

Thus, the data presented in Table 1 indicate that the hastate leaflet is dominant over the cordate. Moreover, two dominant genes, *Tls1* and *Tls2,* with equal effects and segregating independently

control the inheritance of the hastate leaflet in accession G 15935.

Because leaflet shape in common bean is inherited through major genes and is an easily identifiable morphological trait, it can be useful for (i) developing an integrated linkage map, (ii) determining recombinants from inter-gene pool and interracial crosses, and (iii) genetic and selection studies. As hastate leaflets are also found in common bean races Peru and Jalisco, whether their genetic control is similar to that of accession G 15935 from race Chile would be worth investigating.

References

Debouck D, 1991. Systematics and morphology. In: Common beans: research for crop improvement (Schoonhoven A van and Voysest O, eds). Wallingford, U.K.: CAB International and CIAT; 55-118.

Singh SP, Gepts P, and Debouck DG, 1991. Races of common bean (*Phaseolus vulgaris,* Fabaceae). Econ Bot 45:379-396.

Table 1. Shape of the central leaflet of trifoliolate leaves of the parents and F_1 and its segregation in F_2 and backcross generations of a common bean cross (G 2858 x G 15935) evaluated at CIAT-Quilichao, Colombia, 1993.

	Leaflet shape		Phenotypic		
Identification	Hastate	Cordate	ratio	X^2	Probability
G 2858		All			
G 15935	All				
G 2858 x G 15935 (F_1)	All				
G 2858 x G 15935 (F_2)	483	35	15:1	0.2	0.6547
G 2858 x (G 2858 x G 15935)	4	4	3:1	2.6	0.1068
G 15935 x (G 2858 x G 15935)	8		1:0	0.0	1.0000